

The Ground Segment of the EnMAP Mission: from Tasking to Product Download

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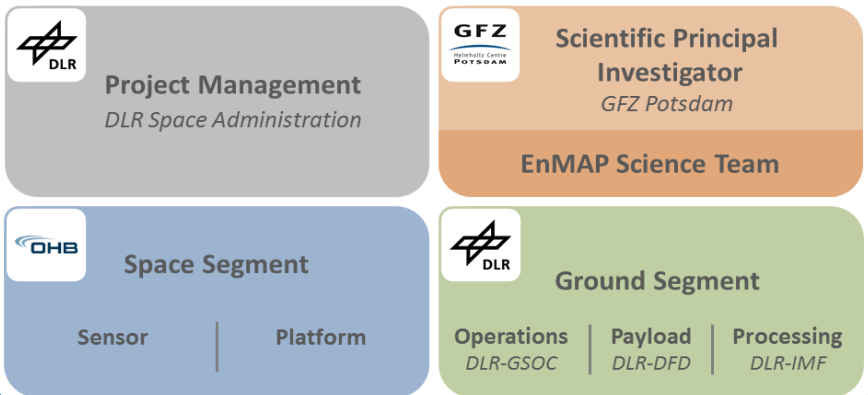
1st EnMAP User Workshop
10 – 11 October 2023

The EnMAP Ground Segment



- Under DLR responsibility and led by the Earth Observation Center (DFD and IMF institutes) and the German Space Operation Center (GSOC)

EnMAP Mission



The EnMAP Ground Segment



Ground Segment

Operations
DLR-GSOC

Payload
DLR-DFD

Processing
DLR-IMF

- Under DLR responsibility and led by the Earth Observation Center (DFD and IMF institutes) and the German Space Operation Center (GSOC)
 - **GSOC:** Mission operations, generate and send telecommands, receive telemetry, flight dynamics, mission planning



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 - **DFD:** Payload data reception, data processing, data archiving and user interfaces (Instrument Planning and EOWEB)



The EnMAP Ground Segment



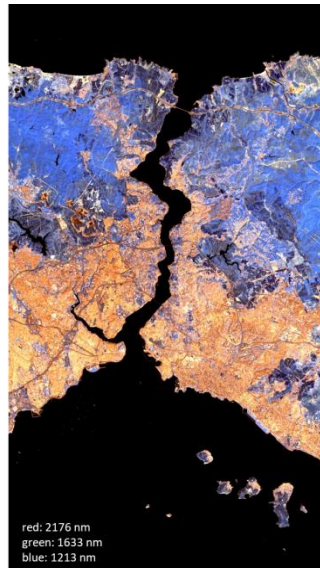
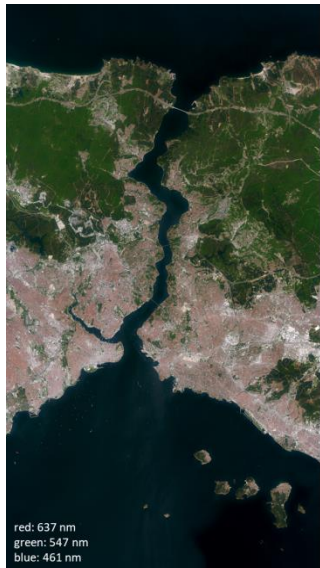
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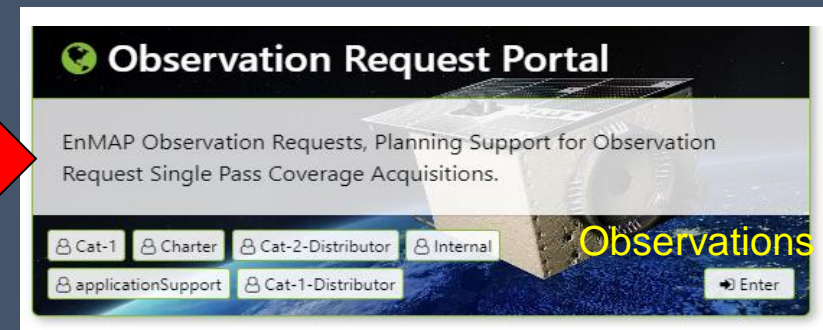
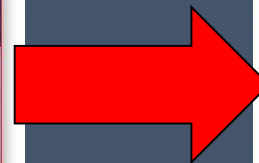
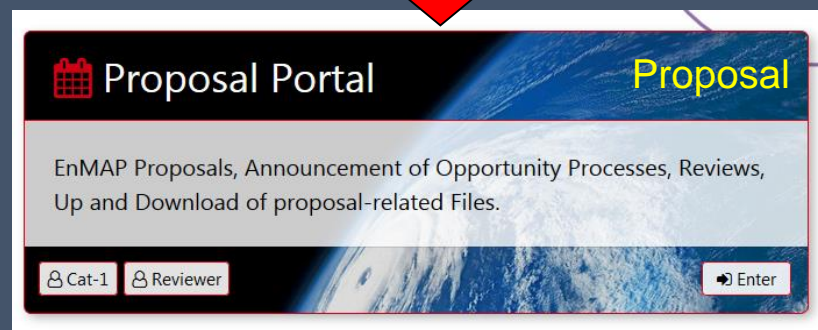
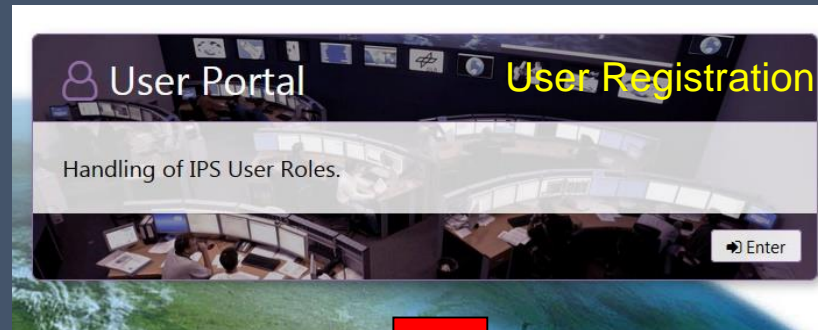
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 - **GSOC:** Mission operations, generate and send telecommands, receive telemetry, flight dynamics, mission planning
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 - **IMF:** Processor development, in-flight calibration and quality control (processed data and instrument)



How to register

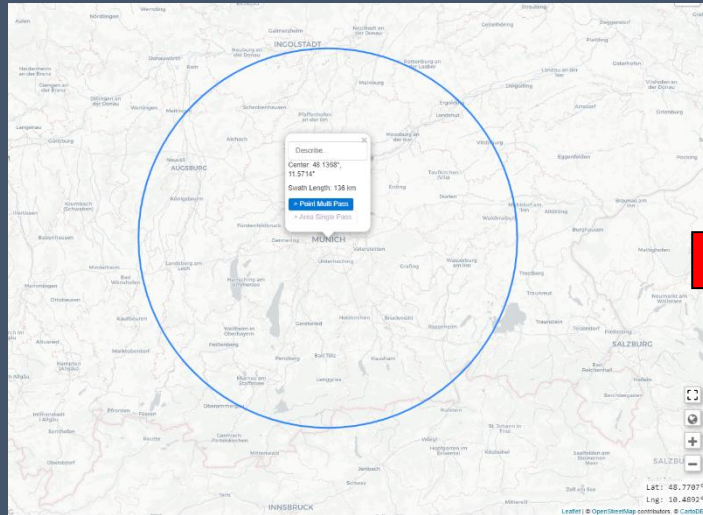
EnMAP Instrument Planning Portal
<https://planning.enmap.org/>

Where users can **register**, submit proposals (necessary to task the instrument) and request future EnMAP acquisitions



How to plan an EnMAP acquisition

EnMAP Instrument Planning Portal <https://planning.enmap.org/>



Mode: POINT MULTI PASS

Datatake Parameters changeable for each datatake anytime before submission...

Start Date (UTC Time) 2023-07-04 End Date (UTC Time) 2023-07-23

Off Nadir Angle -15° to +15° Path Direction descending Swath Length (km) 47

Sunglint Default Parameters used for all datatakes...

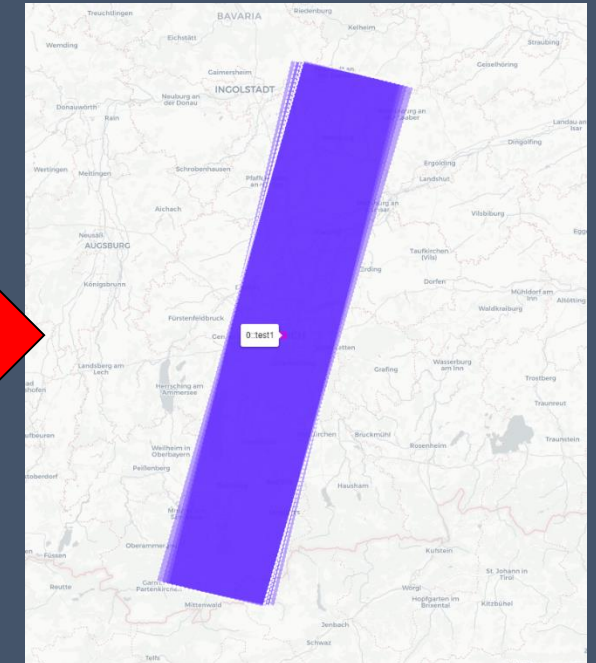
Goal: union: predicted sun glitter... Preview Sunglint: do not return sunglint pixel... Windspeed(s): × 3 m/s × 8 m/s

Coverage Threshold: 100 % Intensity Threshold: 100 % Threshold Type: avoid interference

Cloud Coverage Default Parameters used for all datatakes...

Preview Clouds: do not return clo... Threshold Type: avoid interference Intensity Threshold: 100 % Coverage Threshold: 20 %

[Save & Calculate now](#)



Creating a request does not guarantee entering the satellite schedule. Tasking decision depends on cloud statistics and forecast, satellite restrictions (e.g. maneuvers), priority and quota and number of competing requests

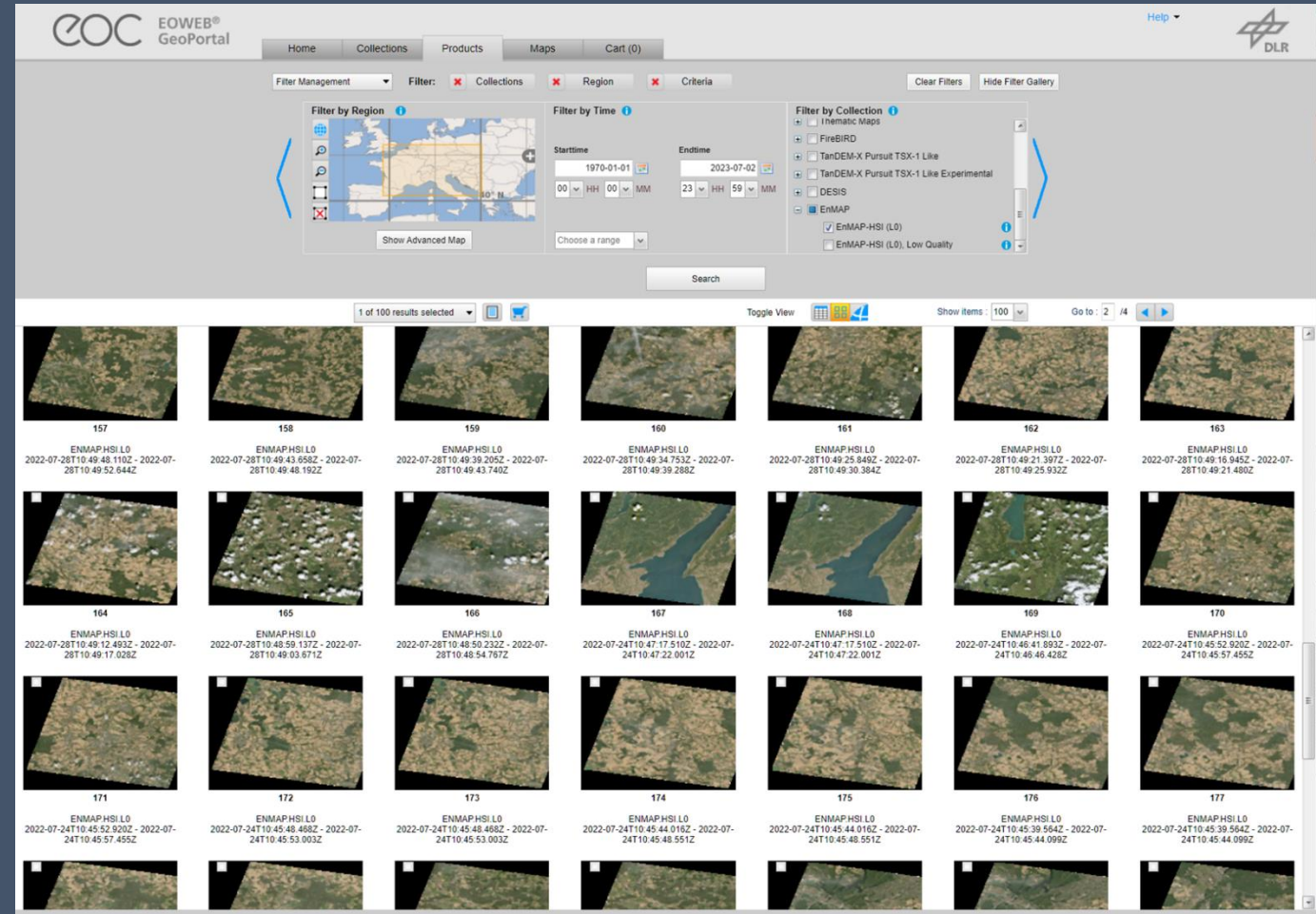
How to get archived EnMAP data

German Satellite Data Archive
through EOWEB
<https://eoweb.dlr.de/egp/>

Where users can browse the EnMAP catalogue and order the products.

Products are processed on-demand, according to different processing options of their choice like:

- Processing level (L1B, L1C, L2A)
- Map projection
- Resampling options
- L2A processing mode (land, water, combined)
- Atmospheric correction parameters



The screenshot displays the EOWEB GeoPortal interface. At the top, there are navigation tabs for Home, Collections, Products, Maps, and Cart (0). Below these are filter management options for Region, Time, and Collection. A search bar is present. The main area shows a grid of 24 satellite imagery thumbnails, each with a number (157-177) and a timestamp. The interface also includes a 'Show Advanced Map' button and a 'Search' button.

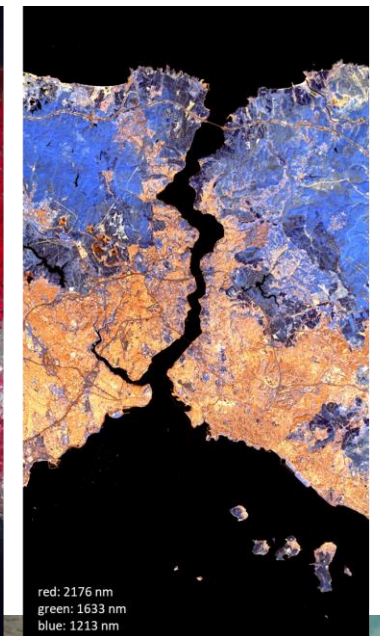


Timeline

LEOP 01.04.2022 – 15.04.2022
 Commissioning 15.04.2022 – 01.11.2022

Launch 01.04.2022
 First light, 27.04.2022

- 01.04.2022 EnMAP Launch
- Start LEOP Phase until 14.04.2022
- 15.04.2022 Start of commissioning Phase
- 27.04.2022 First light



Timeline



LEOP 01.04.2022 –

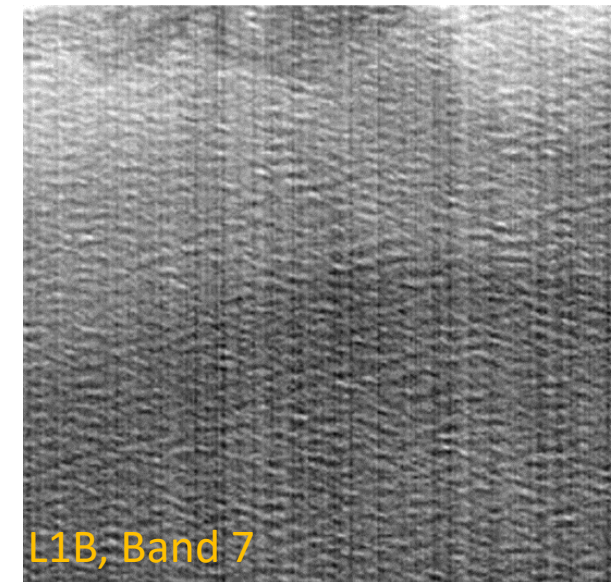
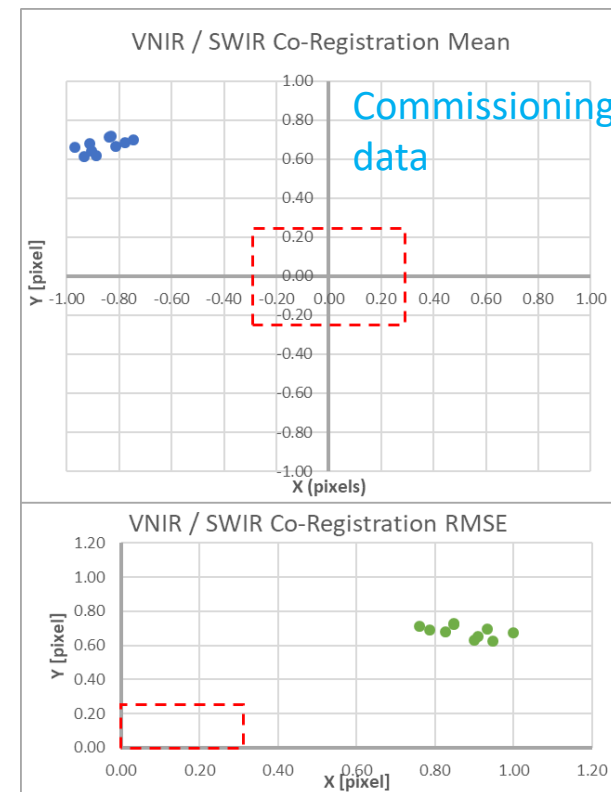
15.04.2022 Commissioning 15.04.2022 – 01.11.2022

Launch

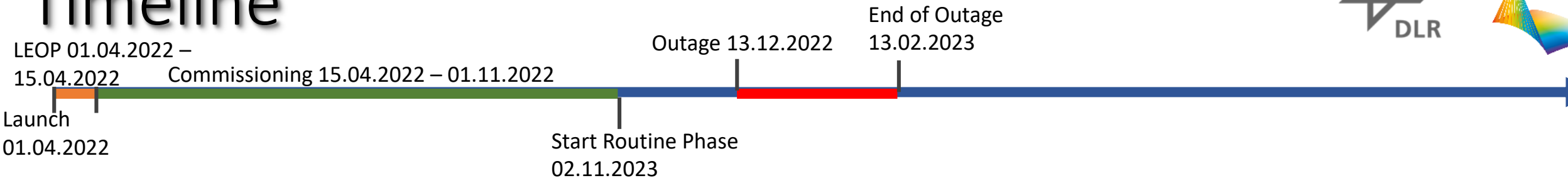
01.04.2022

Start Routine Phase
02.11.2023

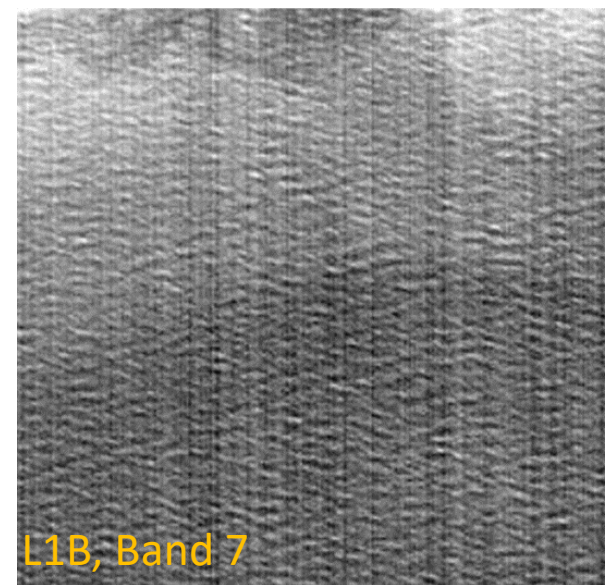
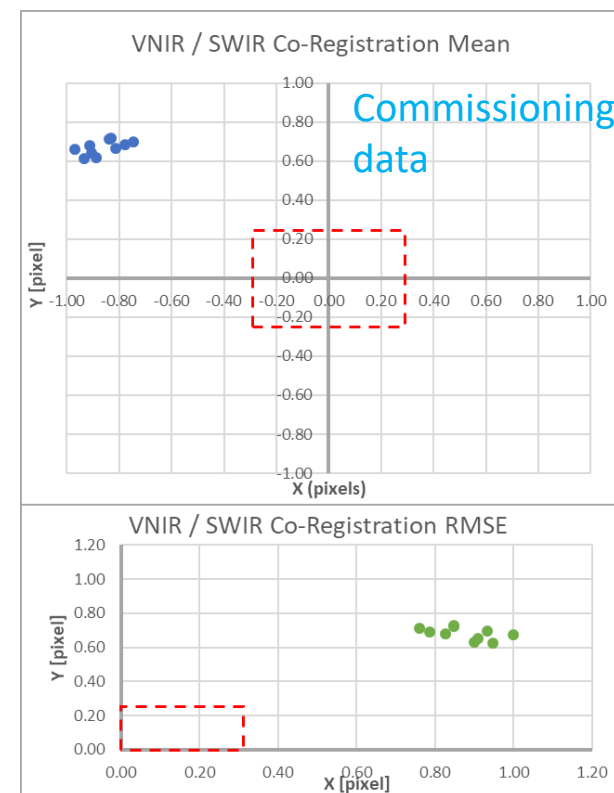
- Start routine phase after successful FQR
 - Data requirements satisfied, except for VNIR-SWIR co-registration (error $\sim 0.7-0.8$ pixel)
 - Request to improve image striping and mitigate effect of VNIR degradation



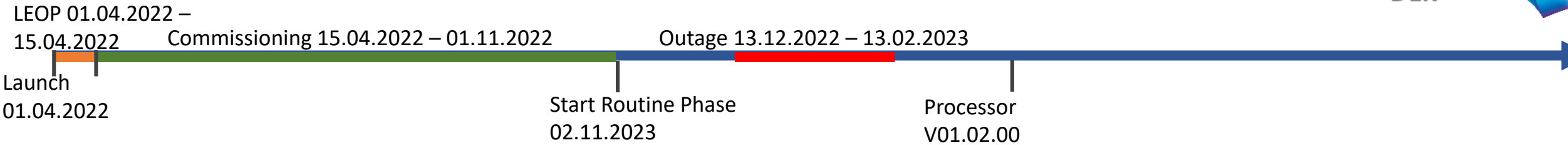
Timeline



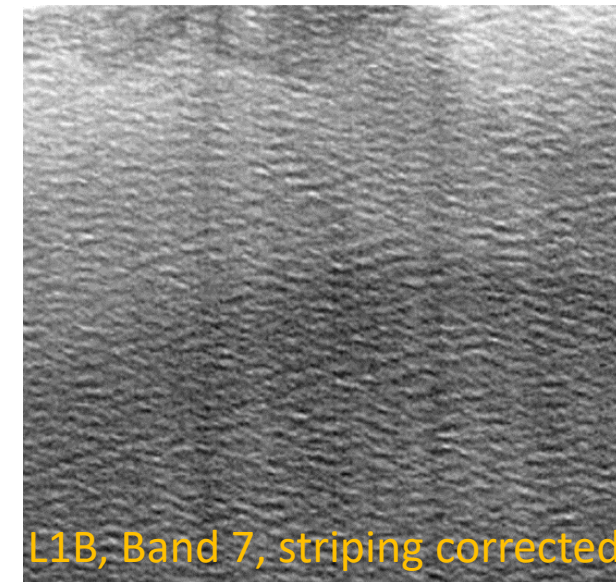
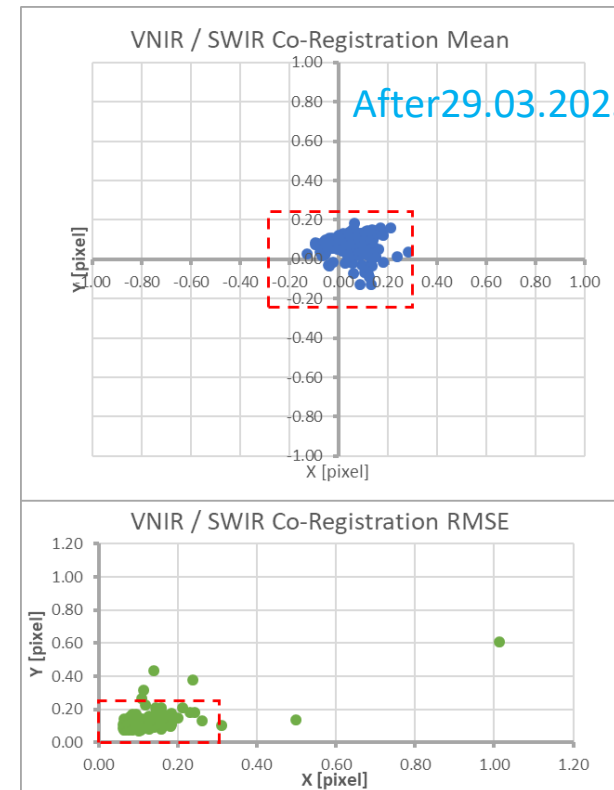
- Start routine phase after successful FQR
 - Data requirements satisfied, except for VNIR-SWIR co-registration (error ~0.7-0.8 pixel)
 - Request to improve image striping and mitigate effect of VNIR degradation
- Failure occurred at the end of a Sun calibration on 13.12.2022. Two months outage to update on-board software



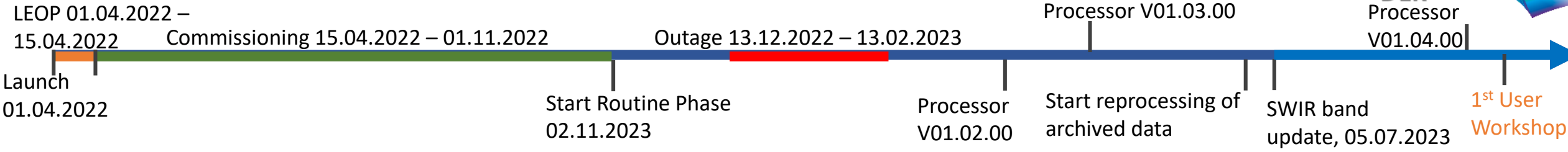
Timeline



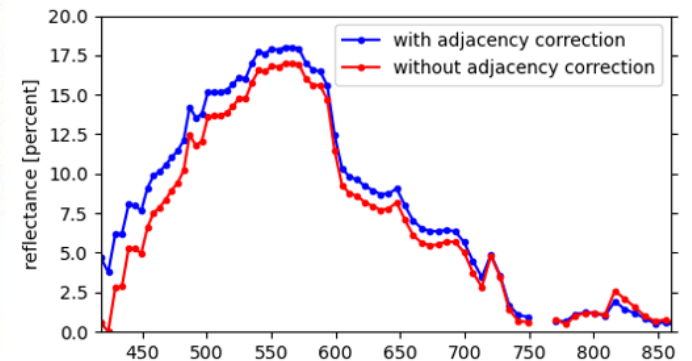
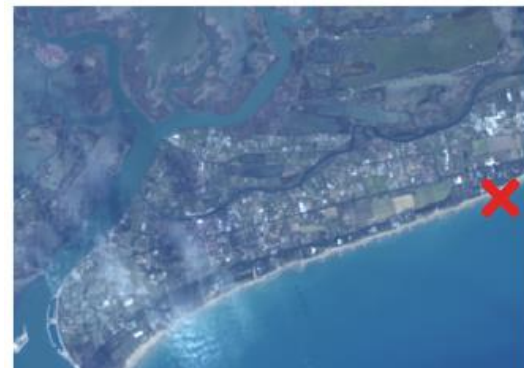
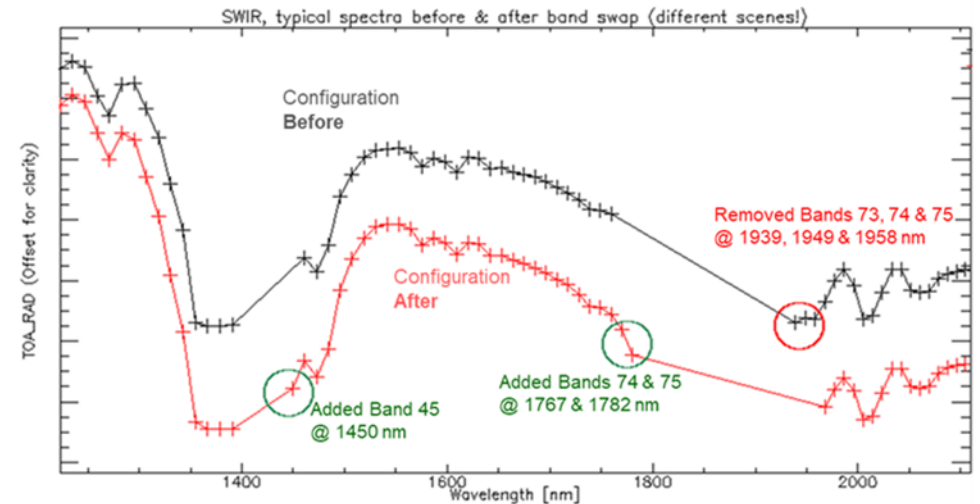
- Operations resumed on 13.02.2023. No consequences on mission functionality or data quality
- Processor update **V01.02.00** on 29.03.2023 with several improvements. Among them:
 - Improved VNIR-SWIR co-registration for newly archived products (<0.1 pixel)
 - De-stripping algorithm
 - Dynamic calibration coefficient
- VNIR degradation was reducing and by end of Q1 2023 had virtually disappeared



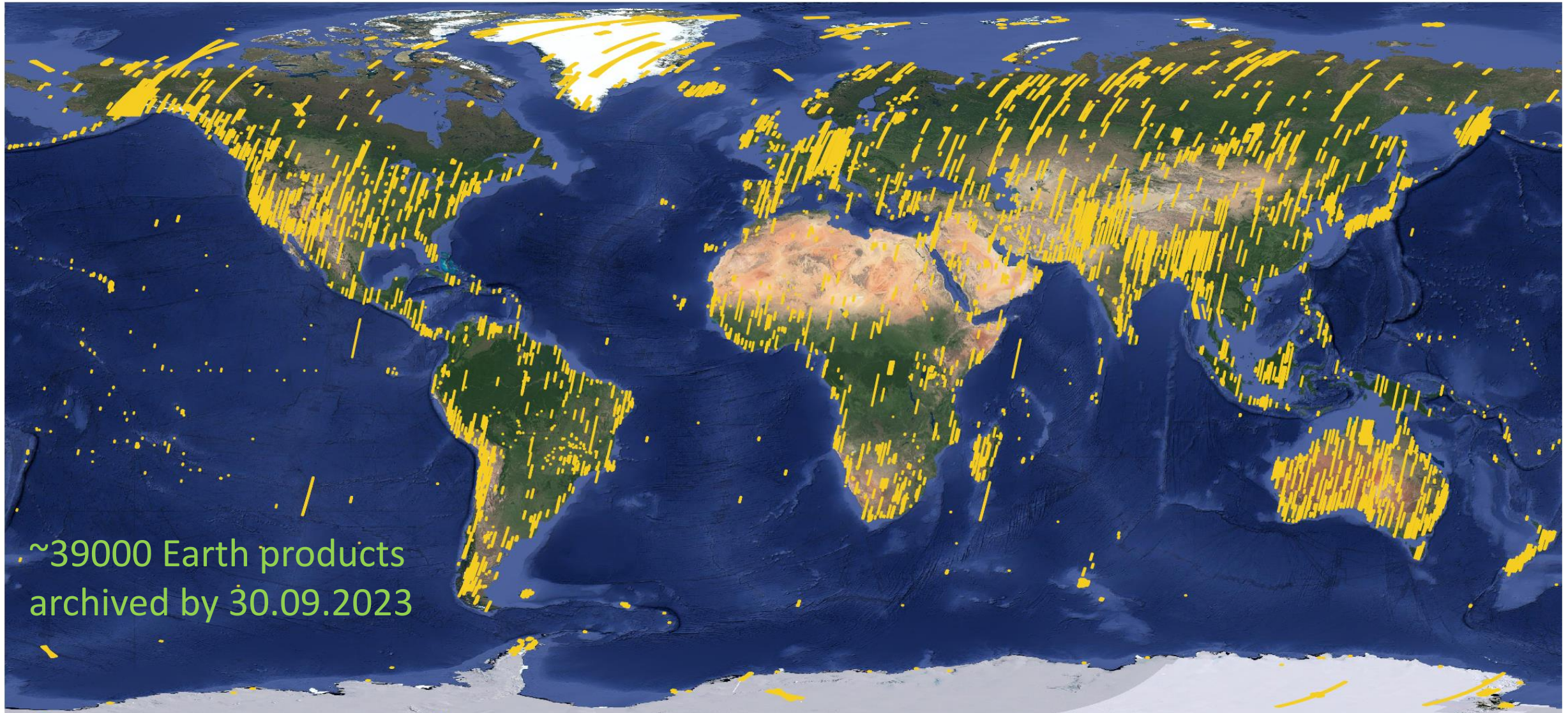
Timeline



- Processor update **V01.03.00** on 02.05.2023. Improved geometric accuracy along-track and other small improvements or bugfixes
- 27.06.2023, start archive re-processing:
 - New versions > **V01.03.00**
 - Highly recommended for commissioning data
- Update of SWIR band configuration on 05.07.2023
- Processor **V01.04.00** on 25.09.2023. Correction of L2A-water adjacency effect



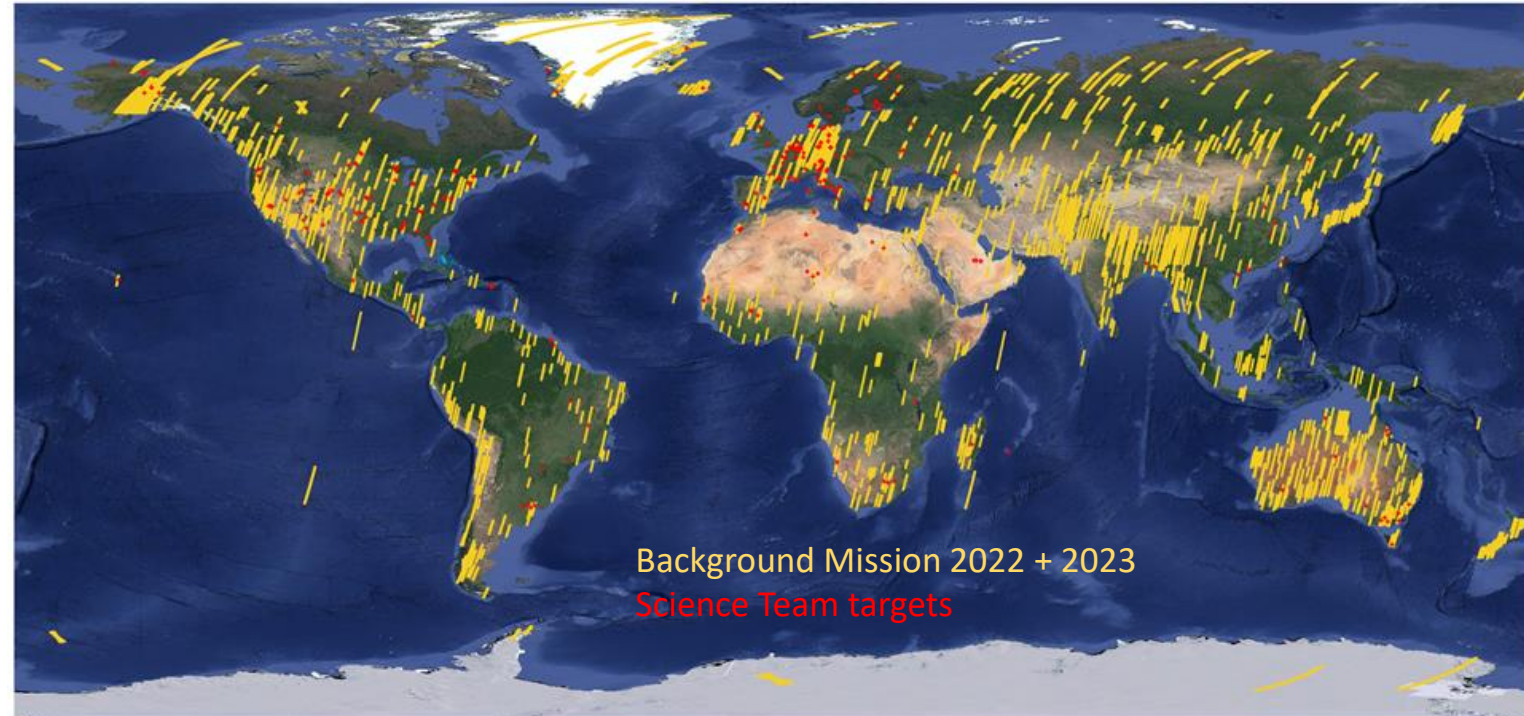
EnMAP acquisitions



~39000 Earth products
archived by 30.09.2023

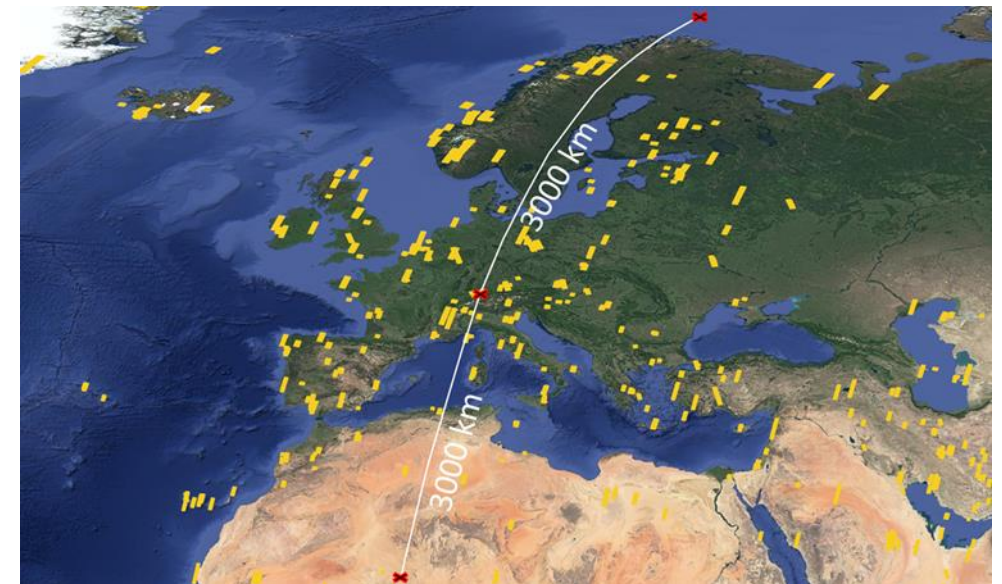
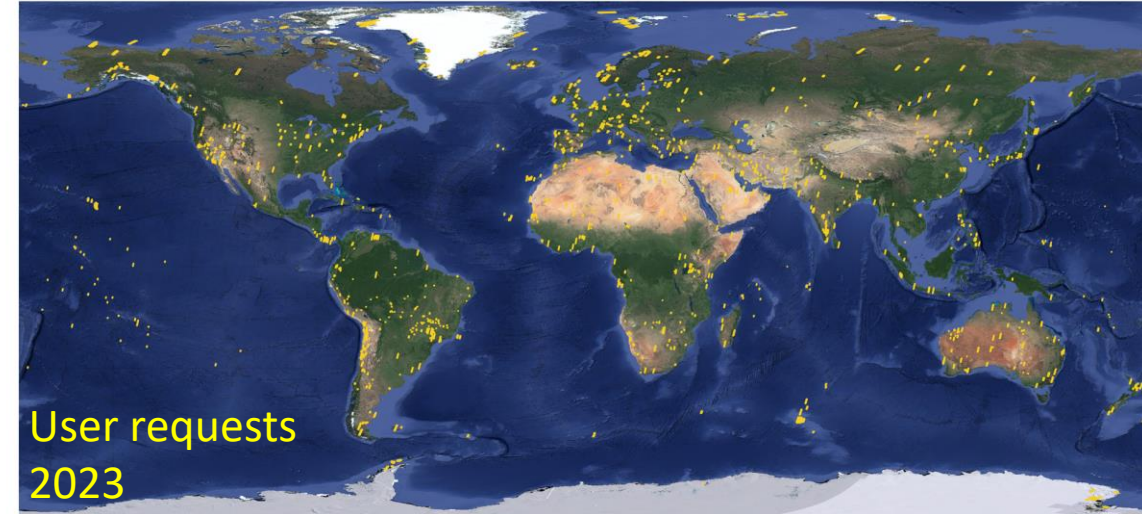
Background Mission

- The EnMAP Mission assigns high priority to user requests (priority 6 and 7 assigned to proposals)
 - Proposals that run out of quota get priority reduced
- Time not used by user requests is assigned to background mission
- BG mission acquisitions are typically longer but with lower priority than user requests, considering the input from the Science Team (list of targets)



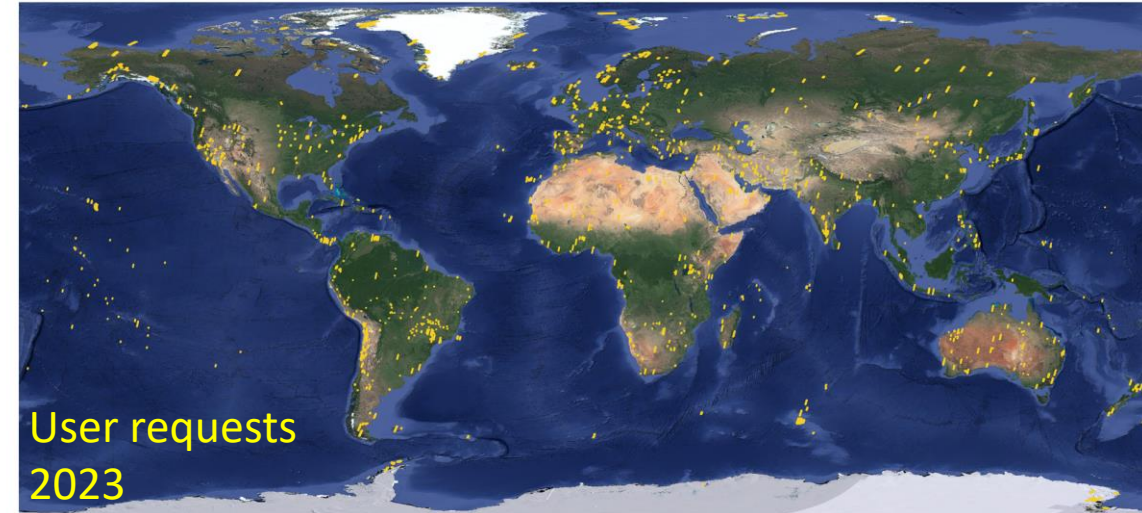
User acquisitions

- Typical user acquisitions are very small (1-3 tiles) and not geographically uniformly distributed. High demand over certain areas (e.g. Europe)
- EnMAP needs ~3000 km (7 minutes) between acquisitions, making the short requests very inefficient
 - Only 1 order gets a slot in the instrument timeline over areas highly requested. High competition between orders
 - Short requests reduce the data volume acquired over the highly demanded areas



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 - Only 1 order gets a slot in the instrument timeline over areas highly requested. High competition between orders
 - Short requests reduce the data volume acquired over the highly demanded areas
- Background mission acquisitions are longer, but with lower priority and don't compete with user requests
 - Temporary implemented “**foreground mission**” to take high priority long acquisitions over certain geographic areas
- Longer-term changes are under evaluation at Mission level



Getting information and news: www.enmap.org



- Main channel to get informed about mission status and news
- Contains additional useful resources for the EnMAP Users

Home Data & Access Mission Science & Applications Tools Events & Education

Welcome to EnMAP

The German Spaceborne Imaging Spectrometer Mission

The Environmental Mapping and Analysis Program (EnMAP) is a German hyperspectral satellite mission that monitors and characterizes Earth's environment on a global scale. EnMAP measures geochemical, biochemical and biophysical variables providing information on the status and evolution of terrestrial and aquatic ecosystems. More information about the main objectives and the status can be found on the [mission page](#).

News

1st EnMAP user workshop - Agenda and late registrations

published on September 28, 2023

The [agenda](#) for the 1st EnMAP user workshop is now online. The workshop will be jointly organized by DLR and GFZ and will take place fully online on **October 10-11, 2023**. For participation without a presentation, [registration](#) is still open until **October 06, 2023**, via the [registration portal](#).

Reactivation of the adjacency correction for L2A water products

published on September 26, 2023

The adjacency processor of the ENMAP atmospheric correction over water was unintentionally deactivated after a previous processor update. Users that requested related products in the time period since November 2022 should note that the adjacency correction over water impacts the accuracy of reflectance products for targets that are close to or surrounded by land, such as inland waters. The enabling of the adjacency correction has been fixed in processor version V01.04.00, which is active in the operation environment since 25.09.2023.

1st EnMAP user workshop

published on August 03, 2023

The 1st EnMAP User Workshop will take place fully online on **October 10-11, 2023**, and will be jointly organized by DLR and GFZ. It will provide a unique opportunity to present, discuss, and explore various topics including sensor characterization, data processing, calibration/validation activities, thematic exploitation in different application fields, user support and training, user

New online course opened in HYPERedu course series 'Beyond the Visible'

published on July 18, 2023

As part of the [HYPERedu education initiative](#), a new Massive Open Online Course (MOOC) on EnMAP data access and image preprocessing techniques was launched and will be permanently available at EO-College following this [Link](#). It complements the MOOC on the principles of imaging spectroscopy (open since November 2021) and the short MOOC on agricultural applications (open since December 2022). More information about the courses as well as the registration links can be found at the [course page](#) at EO-College.

13th EARSeL Workshop on Imaging Spectroscopy - Call for Abstracts

published on July 07, 2023

The 13th EARSeL Workshop on Imaging Spectroscopy will be held in Valencia between April 16 and 18, 2024 (with a tutorial day on 19 April 2024). Abstracts can be submitted between 1st September and 30th October 2023. Please find more details on the [workshop website](#).

EnMAP SWIR band configuration update

published on July 04, 2023

Based on user feedback and in order to harmonize the EnMAP products with other missions, the band configuration of EnMAP will be changed so that new bands are provided to the user in the SWIR range. For this purpose the EnMAP mission is planning to perform an update of the SWIR bands configuration after confirming the success of the test completed during May this year. To perform this change of the instrument configuration, a short outage of a few hours on the morning of 05.07.2023 is required. From that time on, the currently available SWIR bands with approximate center wavelengths 1939, 1949 and 1958 nm will no longer be present in newly acquired EnMAP products and new bands with approximate center wavelengths 1450, 1767 and 1782 nm will be added to the EnMAP products. The total number of SWIR bands after the configuration update will remain constant. Note that all products acquired before 05.07.2023 will not be affected by this change and all products, regardless of their SWIR bands configuration, can be ordered normally with present and future versions of the EnMAP processors.

Re-processing of archived data

published on June 27, 2023

EnMAP has initiated the re-processing of archived data. This activity will be carried out during the upcoming months and will result in harmonised data quality and improved geometric performance. Among the benefits, the re-processed data will offer a significant improvement of the co-registration between the VNIR and SWIR spectrometers. Re-processed products will be added to the archive as they are being re-processed. These data can be easily recognised because they will appear twice in the archive, once with the originally archived version and once with the processor version at the time of the re-processing. For best performance, it is recommended to use the latest version when more than one version of the product exists. Users should check the parameter "archivedVersion" where a version number equal or higher than 01.03.00 will identify a re-processed product (when an older version exists) or a newly created product.

Flood mapping with EnMAP - Provision of crisis information in the frame of the International Charter "Space and Major Disasters"

published on June 26, 2023

After heavy rainfalls between March and May 2023, Somalia was hit by widespread floods. According to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), more than 460,000 people have been affected within the last two months by this disaster.

Introductory videos on the use of the EnMAP Data Access Portal now online

published on June 15, 2023

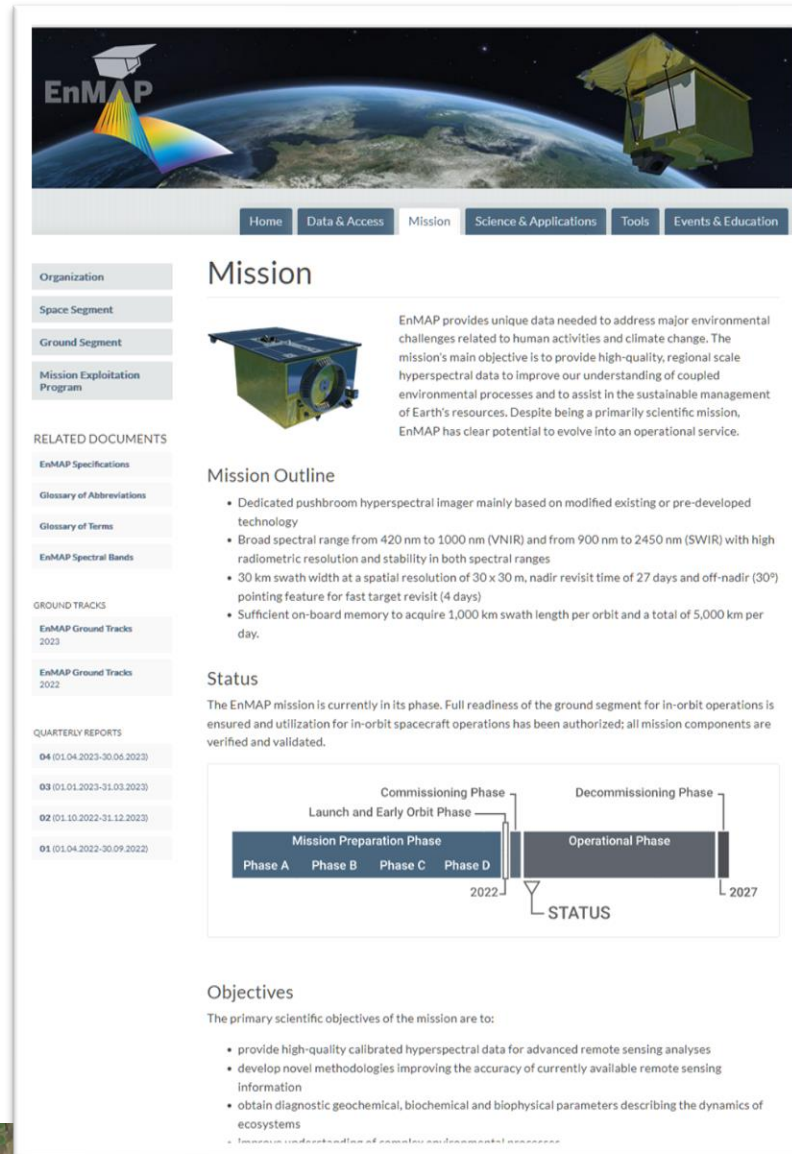
Short video screencasts on how to use the EnMAP Data Access Portal were produced as part of the HYPERedu learning initiative. They are now available online. You can find more information and the links to the screencasts on the [Data & Access](#) page.

EnMAP for monitoring oil slicks offshore Brazil

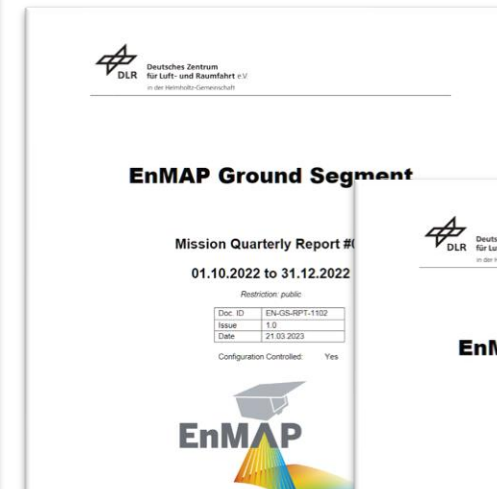
Getting information and news: www.enmap.org



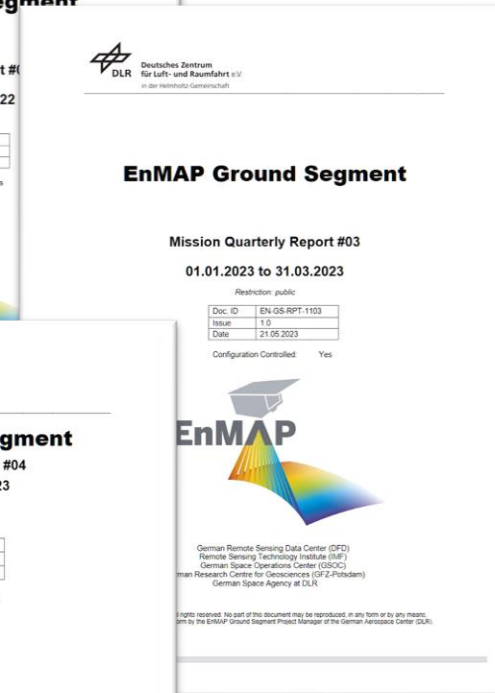
- Main channel to get informed about mission status and news
- Contains additional useful resources for the EnMAP Users
 - **Mission Quarterly Reports**
 - Mission Status and News
 - User and Data Statistics
 - Instrument calibration
 - Data Products quality



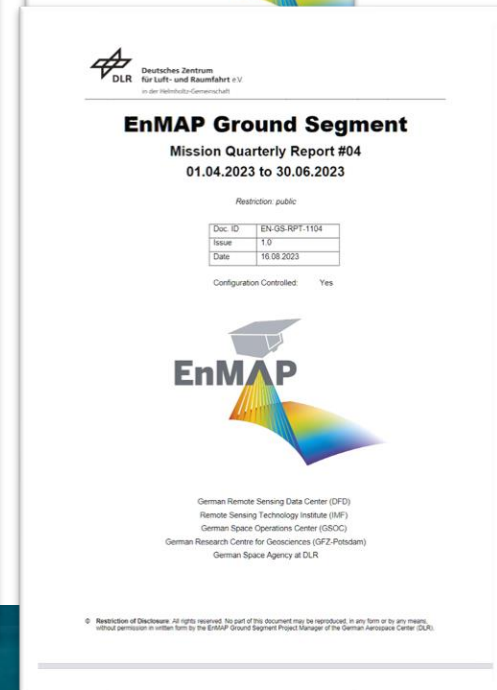
The screenshot shows the 'Mission' page of the EnMAP website. At the top, there is a navigation bar with links for Home, Data & Access, Mission, Science & Applications, Tools, and Events & Education. Below this is a sidebar with a menu for Organization, Space Segment, Ground Segment, and Mission Exploitation Program. The main content area is titled 'Mission' and features a 3D model of the EnMAP instrument. The text describes the mission's objectives: to provide high-quality, regional scale hyperspectral data to improve understanding of coupled environmental processes and assist in the sustainable management of Earth's resources. It also mentions that EnMAP has clear potential to evolve into an operational service. Below the main text is a 'Mission Outline' section with a list of key features: a dedicated pushbroom hyperspectral imager, a broad spectral range from 420 nm to 1000 nm (VNIR) and from 900 nm to 2450 nm (SWIR), a 30 km swath width at a spatial resolution of 30 x 30 m, a nadir revisit time of 27 days and off-nadir (30°) pointing feature for fast target revisit (4 days), and sufficient on-board memory to acquire 1,000 km swath length per orbit and a total of 5,000 km per day. A 'Status' section indicates that the mission is currently in its phase, with full readiness of the ground segment for in-orbit operations authorized. A timeline diagram shows the mission phases: Mission Preparation Phase (Phase A, B, C, D) from 2022 to 2022, followed by the Operational Phase from 2022 to 2027, with Commissioning and Decommissioning phases at the beginning and end. The 'RELATED DOCUMENTS' sidebar lists EnMAP Specifications, Glossary of Abbreviations, Glossary of Terms, EnMAP Spectral Bands, GROUND TRACKS (EnMAP Ground Tracks 2023, 2022), and QUARTERLY REPORTS (04 (01.04.2023-30.06.2023), 03 (01.01.2023-31.03.2023), 02 (01.10.2022-31.12.2022), 01 (01.04.2022-30.09.2022)).



The cover of the 'EnMAP Ground Segment Mission Quarterly Report #03' for the period 01.10.2022 to 31.12.2022. It is a public document with Doc ID EN-GS-RPT-1102, Issue 1.0, and Date 21.03.2023. The report is published by the German Aerospace Establishment (DLR) and includes the EnMAP logo.



The cover of the 'EnMAP Ground Segment Mission Quarterly Report #04' for the period 01.04.2023 to 30.06.2023. It is a public document with Doc ID EN-GS-RPT-1104, Issue 1.0, and Date 16.08.2023. The report is published by the German Aerospace Establishment (DLR) and includes the EnMAP logo. It also lists the German Remote Sensing Data Center (DFD), Remote Sensing Technology Institute (RTI), German Space Operations Center (GSOC), and German Research Centre for Geosciences (GFZ-Potsdam) as contributing institutions.



The cover of the 'EnMAP Ground Segment Mission Quarterly Report #02' for the period 01.10.2022 to 31.12.2022. It is a public document with Doc ID EN-GS-RPT-1103, Issue 1.0, and Date 21.05.2023. The report is published by the German Aerospace Establishment (DLR) and includes the EnMAP logo. It also lists the German Remote Sensing Data Center (DFD), Remote Sensing Technology Institute (RTI), German Space Operations Center (GSOC), and German Research Centre for Geosciences (GFZ-Potsdam) as contributing institutions.



Getting information and news: www.enmap.org



- Main channel to get informed about mission status and news

- Contains additional useful resources for the EnMAP Users

- **Mission Quarterly Reports**

- Mission Status and News
- User and Data Statistics
- Instrument calibration
- Data Products quality

- **Ground tracks (KML files)**

Mission

EnMAP provides unique data needed to address major environmental challenges related to human activities and climate change. The mission's main objective is to provide high-quality, regional scale hyperspectral data to improve our understanding of coupled environmental processes and to assist in the sustainable management of Earth's resources. Despite being a primarily scientific mission, EnMAP has clear potential to evolve into an operational service.

Mission Outline

- Dedicated pushbroom hyperspectral imager mainly based on modified existing or pre-developed technology
- Broad spectral range from 420 nm to 1000 nm (VNIR) and from 900 nm to 2450 nm (SWIR) with high radiometric resolution and stability in both spectral ranges
- 30 km swath width at a spatial resolution of 30 x 30 m, nadir revisit time of 27 days and off-nadir (30°) pointing feature for fast target revisit (4 days)
- Sufficient on-board memory to acquire 1,000 km swath length per orbit and a total of 5,000 km per day.

Status

The EnMAP mission is currently in its phase. Full readiness of the ground segment for in-orbit operations is ensured and utilization for in-orbit spacecraft operations has been authorized; all mission components are verified and validated.

Objectives

The primary scientific objectives of the mission are to:

- provide high-quality calibrated hyperspectral data for advanced remote sensing analyses
- develop novel methodologies improving the accuracy of currently available remote sensing information
- obtain diagnostic geochemical, biochemical and biophysical parameters describing the dynamics of ecosystems



Getting information and news: www.enmap.org



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 - **Example Data Products**
 - 3 Scenes (Tyrol, Groningen and Nevada)
 - 3 processing levels for each scene (L1B, L1C, L2A)

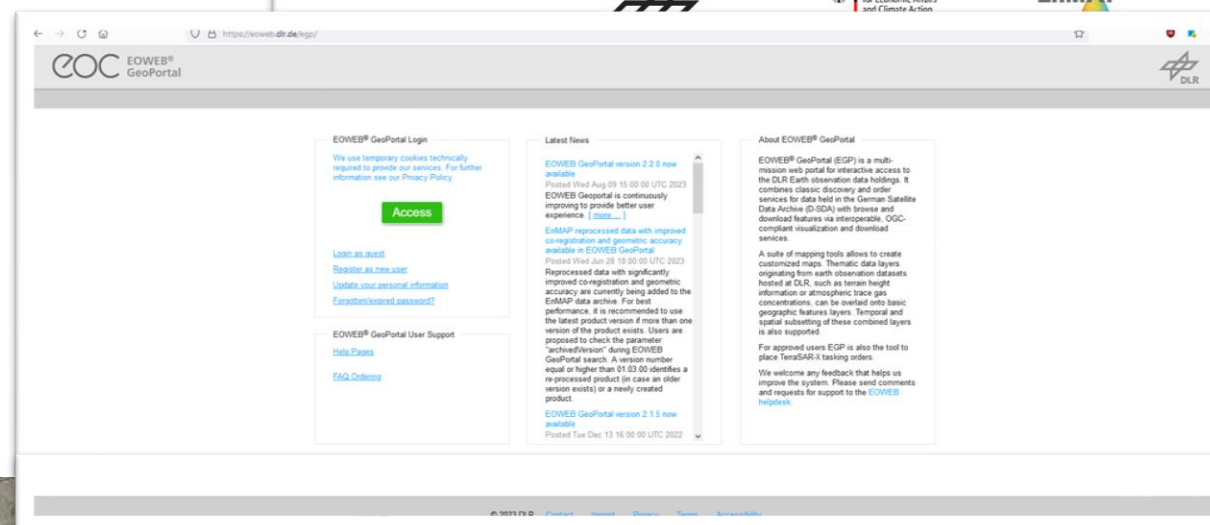
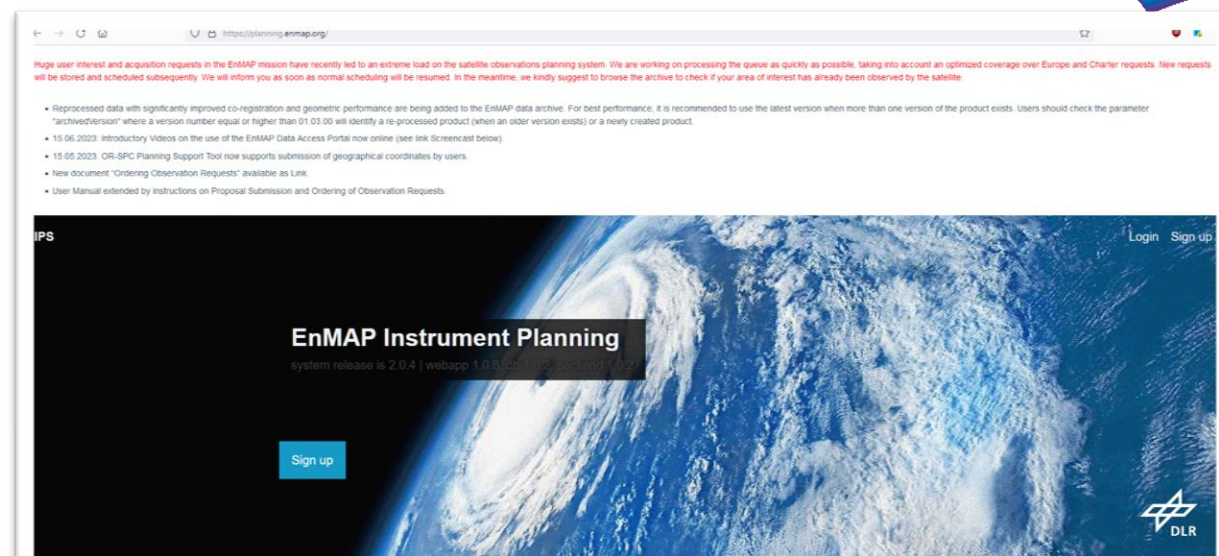
The screenshot shows the EnMAP website interface. At the top, there is a navigation bar with links for Home, Data & Access, Mission, Science & Applications, Tools, and Events & Education. Below the navigation bar, there is a sidebar with links to EnMAP-Box, EnMAP Campaign Portal, Simulated EnMAP Data, and EnMAP Example Data Products. The main content area is titled 'EnMAP Example Data Products' and contains two product listings. The first listing is for 'Tyrol, Austria', dated 12 June 2022, and includes a description of the L2A product, processing details, and download buttons for L1B, L1C, and L2A. The second listing is for 'Groningen, Netherlands', dated 10 August 2022, and includes a description of the L2A product, processing details, and download buttons for L1B, L1C, and L2A. The background of the website features a satellite image of Earth with the EnMAP satellite in orbit.

Getting information and news: www.enmap.org



- Main channel to get informed about mission status and news
- Contains additional useful resources for the EnMAP Users
- Additional important notices published at IPS and EOWEB sites

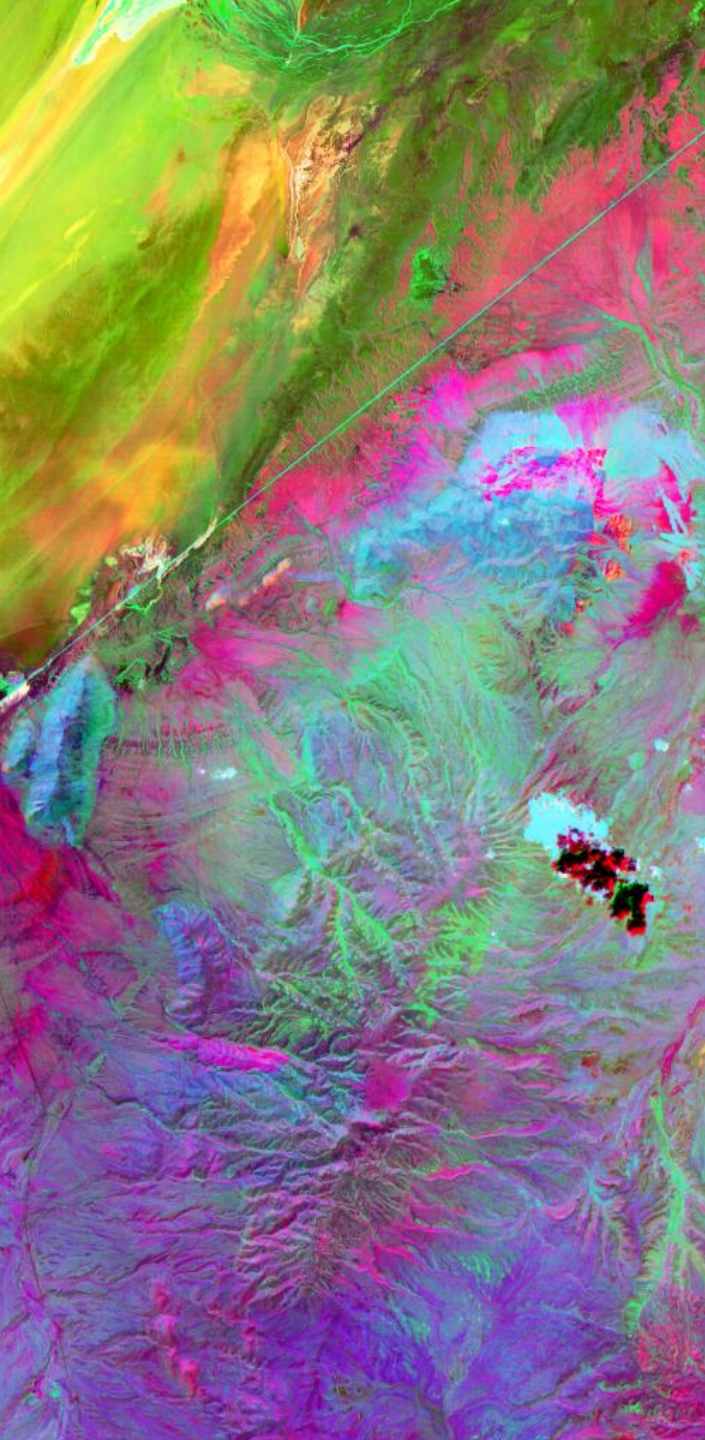
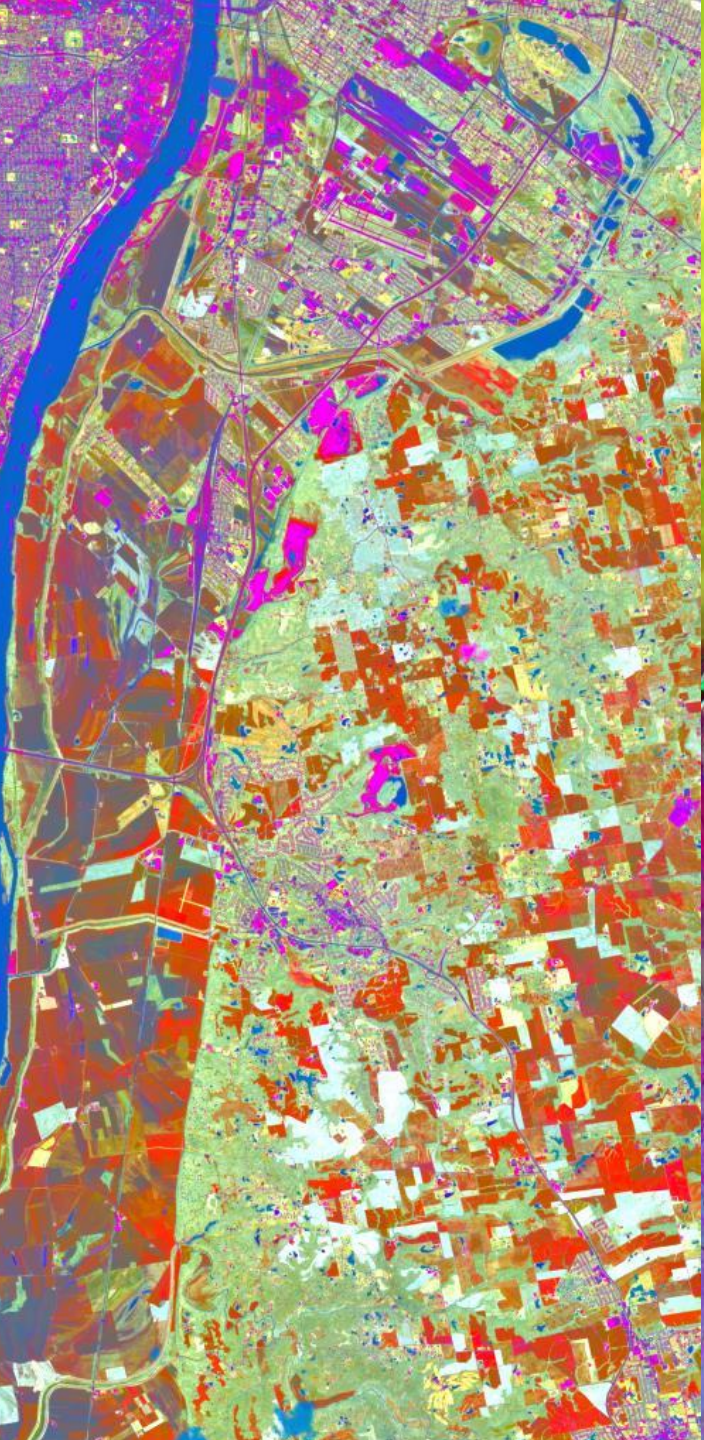
- <https://planning.enmap.org/>
- <https://eoweb.dlr.de/egp/>



Summary



- Improvements in Ground Segment services / data quality, specially during 1st year
 - Check when data were acquired (performance may differ)
 - When possible use re-processed data
- High demand of user acquisitions on certain geographic areas combined with minimum time between EnMAP acquisitions creates a queue of requests not fulfilled. Situation is very inefficient due to very short acquisitions with high priority. Adjustments are necessary to improve the situation for all users
- Check www.enmap.org news feed and Mission Quarterly Reports to get latest status of the EnMAP Mission



Thank you !

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